Again, at a general meeting of the Scotch Society in July, 1877, the Chairman, in his address, renewed his reference to the desirability of a station on, at all events, Ben Nevis, and mentioned that Lord Abinger, the proprietor, having consented to the erection of a hut for the purpose, "the Society's Council would readily establish the station if it only had the requisite funds." Testimony to the value of high stations has in like manner been given by Mr. Robert Scott, the Secretary of the Government Meteorological Department.

Mr. Scott was the first and principal witness examined before the recent Government Meteorological Commission, and his opinion on the point of high-level stations is shown by the following questions and answers :—

Q. Has the Meteorological Committee felt it desirable to have stations at some higher levels in Great Britain ?
A. Certainly they have.
Q. Have they thought of any particular plan ?
A. They have had no money for it.
Q. Have they thought of any place if they had money ?
A. I may mention Settle, because there is a telegraph station there, a high-level station, about 1,000 feet above the sea, on the borders of Yorkshire and Lancashire. If ever we had 30*l.* a year to spare, we should like to have a station there. It is found in cold weather that warm weather sets in at the upper stations perhaps one or two days before it comes down.

When such are the opinions which have been expressed and brought before the country by authorities deserving of respect and attention, it is hoped that the establishment of high-level meteorological stations will be no longer delayed. It is true that none of the mountains in the United Kingdom are so high as in the other countries above enumerated where high-level stations have been and are about to be established. But on the other hand the British Isles occupy a position more important for meteorological purposes than almost any other European country, inasmuch as their westward position enables British meteorologists to obtain the earliest information regarding the great storms which sweep across the Atlantic, and of which warning as soon as possible should be given in Europe. Great Britain's duty, interest, and credit as a nation concur therefore in this matter ; and it is hoped that measures will soon be taken to establish these high-level stations in the three divisions of the United Kingdom, unless, in fact, we are prepared to see the problems presented by the phenomena of the higher air worked out in other countries.

COAL

Coal: its History and Uses. By Professors Green, Miall, Thorpe, Rücker, and Marshall, of the Yorkshire College. Edited by Prof. Thorpe. (London : Macmillan and Co., 1878.)

I SHALL be much surprised if this composite little volume fails to attract the attention of many students of nature, but especially of such persons as are practically connected with coal, either as students, as proprietors, or as workers. The five professors of the Yorkshire College of Science who have combined to produce the volume are men thoroughly competent to deal with the portions of the subject which they have severally undertaken, and the result of their labours is a book at once picturesque and scientific.

Prof. Green commences the work by two chapters on the geology of coal. After dealing with the general phenomena of the deposition of sandstones, shales, and limestones, he proceeds to examine the special features of coal and the probable conditions attending its formation. In doing so he grapples with the peculiar questions connected with the well-known lamination of coal and the alternation of the brittle, lustrous, bituminous layers with those of the so-called mother-of-coal or mineral charcoal. This subject of course raises the question of the origin of these two elements—a question which still presents curious and unsolved difficulties. The mineral charcoal chiefly consists of cubical fragments of bark mingled with some vascular or woody elements of plant-stems. Prof. Green correctly points out that "the woody character of this mother of coal is palpable even to the unaided eye," further adding "that it is possible, in some cases, to say what the plant was of which they (*i.e.*, the fragments of charcoal) originally formed a part." I am afraid that this latter feat is not easily performed. The vascular tissues which we chiefly find in this mineral charcoal are not those seen in Lepidodendron and in Sigillaria. The absence of the latter structures is one of the facts not easily explained. The vessels forming the ligneous zones of these two representatives of the carboniferous flora are always of the barred or pendoscalariform type. The dominant element in the mineral charcoal consists of the various modifications of cellular tissue found in the bark of these, and many other unrecognisable, plants, but the vessels are mainly of the reticulated type. They closely resemble the vascular elements found in some Calamites, in most Asterophyllites and Sphenophylla, and in all the known Lyginodendra. Whether the barred vessels of the Lycopodeaceous plants did not form a part of the vegetable mass converted into coal, or whether, being there, they were, bituminised more readily than others, is not easy to say. I am inclined to believe in the latter explanation ; anyhow, I have as yet failed to find a solitary fragment of one of these *barred* vessels in the mineral charcoal. A fragment of American coal, sent to me many years ago by that distinguished microscopist, Dr. Bailey, of West Point, consisted wholly of numerous layers of similar reticulated vessels which had not undergone bituminous disintegration. The laminæ of mineral charcoal alternate with those of the more bituminised coal with great irregularity ; in some specimens they are distributed in about equal quantities, in others thick bituminous layers separate the charcoal layers very widely. Whatever the agency may have been that brought about the result, this lamination shows that, in most instances, there have been irregularly recurring periods when innumerable, perfectly carbonised, but only partially disorganised, fragments of certain decaying stems were strewed over the surfaces of those portions of the vegetable mass which became converted into the more bituminous laminæ of the coal. In other cases I find no difficulty in seeing the charcoal intermingled with, and actually undergoing conversion into, the bituminous condition, whilst interposed layers of perfect macrospores have undergone no such conversion. The charcoal fragments are precisely such as we see when an old post, or the stem of a dead tree, undergoing decay, is breaking up into small cubical or rectangular pieces, and which would float freely upon the surface of an overflowing current of water.

My present impression is that these charcoal layers have originated in the decay of aged stems, such as have produced the "pot-stones" and "pot-holes" common in our coal-mines. The wood and the greater portion of the bark would accumulate, in a fragmentary state, within the hollow cylinders of the less easily destroyed bast-layer of the bark of such stems, until some recurring flood converted the damp ground into a temporary shallow lake, filling all these cylinders with water, when all such fragments would speedily float out, leaving the empty cylinders to be occupied by the sands and clays by which they are almost always permanently filled. The displaced vegetable fragments would swim freely for a time, diffused widely over the surface of the waters, but, as the latter subsided, they would settle down upon the layers of more completely disorganised vegetable soil, which, being already damp and soddened, would be likely to remain undisturbed by the temporary and sluggish currents that would exist where a forest-covered swamp was thus overflowed.

Prof. Green appears to balance very fairly the respective measures in which reproductive spores and the merely vegetative portions of the Carboniferous plants have contributed their quota to the carbonaceous mass. At the same time, much more work remains to be done before our theories on this subject can be regarded as wholly satisfactory.

The chief point in Prof. Green's work which I should be disposed to criticise is his map representing the probable distribution of sea and land during the carboniferous age. We are so ignorant of the extent to which denudation has affected vast geographical areas, that all such attempts appear to be inevitably hypothetical. At the same time Prof. Green's reasonings on the subject are extremely plausible and ingenious.

The third chapter of the volume is devoted to the coal plants—especially to the two types of Calamites and Lepidodendron, with the near relative of the latter, the Sigillaria. Since this portion of the volume is avowedly based upon my own memoirs, criticism of any kind would be out of place here. I would only observe that Prof. Miall appears to have reproduced my notions, be they right or wrong, with great accuracy. I may, however, observe here that one of the points for which I have so long contended, in opposition to my French friends, viz., the close identity of Asterophyllites and Sphenophylla, has just received unanswerable confirmation. Herr von Stur *has obtained both these types of foliage upon one single plant*, the former being the ordinary vegetative foliage, and the latter the whorls of leaves belonging to the fruiting branches.

In the fourth chapter we find Prof. Miall upon his own ground. In it he deals with the animals of the coal-measures, to the history of many of which he has made such valuable contributions. The chapter affords a rich illustration of the progress which the animal palæontology of the coal-measures has made during the last half century. Within that period Dr. Hibbert first called attention to the large teeth and bones of the Burdie-house limestone. It was only in the third decade of the century that we began to find scanty fragments of similar objects in the Ardwick limestones of Manchester, and it was at a yet later period that the Wigan Cannel was found to be rich in remains of similar objects. How changed this portion of our knowledge now is the reader of Prof. Miall's interesting chapter will readily learn. Prof. Miall wisely explodes the baseless notion of an atmosphere ladened with a superabundance of carbonic acid—existing during the Carboniferous age—a notion which still reappears in some geological works, but which rests upon no probable foundation. On the other hand he very correctly shows the importance of studying the fishes of the Carboniferous rocks when attempting to classify these rocks by the light of their animal remains. He points out the rarity of the Carboniferous Ganoids in the mountain limestone contrasted with the comparative abundance of the Elasmobranchs—a statement which every geologist familiar with these rocks will readily confirm, and he shows also how difficult it is to determine between the several influences of marine and fresh-waters in producing the Carboniferous beds. At the same time, fully admitting the correctness of Prof. Miall's statement that the Ganoids become proportionately more numerous as we ascend from the limestone to the newer beds, the Elasmobranchs in the upper coals of Lancashire and Yorkshire are far more numerous than in any known estuarian or fresh-waters at the present day, and consequently they place a great difficulty in the way of our regarding the upper Carboniferous, sedimentary deposits as being absolutely due to fresh water. Prof. Miall admits that his conclusions on this point compel us to admit "the supposition that the Elasmobranchs were more largely fluviatile than in any other periods." On the other hand, seeing how largely the noble ganoids of the Permian, Liassic, and Cretaceous ages were undoubtedly marine, it may be as readily contended that the Carboniferous Ganoids were marine as that their Elasmobranch companions were fresh-water.

In the fifth and sixth chapters the chemistry of coal is dealt with. For this portion of the work I presume we are wholly indebted to Prof. Thorpe and his auxiliaries in his Leeds laboratory. This portion of the work is of high interest. Dr. Thorpe has made numerous new analyses, and amongst other matters he has endeavoured to throw further light upon the question first raised by Prof. Huxley, viz., the true influence of Lycopodeaceous spores in producing the bituminous portions of the coal. But though Prof. Thorpe's researches into this question are highly interesting, the problem is far from solved; hence I believe he proposes to carry out a further series of analyses, in the hope of throwing further light upon this obscure but important subject. Space does not admit of my referring to the numerous other chemical aspects of coal which Prof. Thorpe so carefully records.

The four remaining chapters deal respectively with coal as a source of warmth, a source of power, and with what is commonly called the coal question; in the *two* latter chapters, ground gone over by Prof. Jevons, some years ago, is again traversed by Prof. Marshall. To attempt to criticise these latter chapters would be presumptuous on my part, still I cannot quite accept Prof. Marshall's conclusions that what he calls "physical waste" in contradistinction to "commercial waste," should be allowed to go on. If his argument is a sound one, a tenant is justified in only getting such coal as is *most* cheaply obtained, and in leaving buried in the bowels of the earth, unattainable by future generations, valuable material merely because the getting of it would involve more cost than would attend the raising of coal from thicker and more cheaply workable seams. When a tenant rents *all* the coals under a given acreage of ground his interest in the property is temporary and limited. It is therefore to his interest to raise only such coal as can be most cheaply raised in the shortest space of time. It is not necessary that the raising of the coal which he thus abandons should involve an actual loss to the tenant. It is enough for the argument that he would have to raise it at a diminished profit, which he will certainly not do if he is permitted to devote the same time and labour to such coal as will leave him more profit. Of course freedom of trade and labour suggest that a man should be allowed to pursue the course most profitable to himself, but seeing the vital importance of our coal supply to our existence as a manufacturing nation, it does appear to me that the coal-raiser should be prevented by the lord of the manor primarily—or, if he fails to do his duty, by the legislature—from thus wasting the chief instrument in the production of our national wealth—even if such interference involved some reduction of his profits, or of some addition to the price of coal.

I need not say more to show the interesting character of the contents of this unpretending volume. It is most creditable to its authors, and I shall be much surprised if its merits do not meet with a wide recognition.

W. C. WILLIAMSON

ASCENSION

Six Months in Ascension; an Unscientific Account of a Scientific Expedition. By Mrs. Gill. (London: John Murray, 1878.)

THOSE who know anything of Ascension will wonder how on earth any one could find sufficient material during even a six months' stay to write a volume of 300 pages upon it. We doubt if any one but a lady circumstanced as Mrs. Gill was could have made a readable story out of the barren materials to be found on this land-ship of an island, as it really is, to all intents and purposes; and she has managed to write a thoroughly interesting narrative. If every scientific worker were as fortunate as Mr. Gill in having so sympathetic a companion and coadjutor to tell all the circumstances of his work, the world might think a great deal more of those apparently dry figures and easily-expressed results, which seem to have no touch of nature about them. To those who see only the scientific side of the matter, it may seem a very simple and very pleasant thing to watch the stars night after night; let such read Mrs. Gill's book, and perhaps they will have more sympathy and perhaps a little pity for astronomers sent on scientific expeditions to remote islands.

Mr. Gill, as many of our readers will remember, spent the last six months of 1877 on the Island of Ascension for the purpose of observing Mars in opposition, an opportunity occurring then such as would not occur again during the century. Lord Lindsay lent his celebrated heliometer, the Astronomical Society granted 500*l.*, and the Admiralty did all in their power to make Mr. Gill's sojourn on Ascension as pleasant and successful as possible. In an introductory chapter Mr. Gill gives an exceedingly interesting sketch of the principal previous attempts which have been made to measure the distance of the sun, and the results that have been come to with regard to that hitherto rather inconstant "constant." The perusal of this chapter will not only be instructive to the general reader, but must greatly increase the interest of the subsequent narrative, showing as it does the important results that depended on the success of the expedition, the human side of which is so graphically described by Mrs. Gill. She herself gives a brief but very successful explanation, in popular language, of how the sun's distance is measured.

As outgoing vessels seldom touch at Ascension, the expedition, consisting of Mr. and Mrs. Gill, with their heavy baggage, were detained for some time at St. Helena, a detention which both seem to have enjoyed. Mr. Gill succeeded in finding what he, with considerable probability, surmises to have been the site of the observatory used by Halley, in 1677, to observe the transit of Mercury, and make his catalogue of southern stars. They of course saw all the lions of the island, and Mrs. Gill's descriptions are so clear and fresh that even those who have read much about St. Helena will find in them much to interest. Even when Ascension was reached, it was no easy matter to land through the great "rollers" which are so characteristic a feature of some Atlantic islands. We hear a good deal about these puzzling phenomena, which are so difficult to account for, but which Mrs. Gill is inclined to think are probably due to the cause suggested by Capt. Evans. That keen-sighted hydrographer thinks these rollers are probably the far-reaching result of the breaking-up of the continents of ice in the Antarctic regions, miles and miles of which break off, and, plunging into the sea, give rise to huge submarine waves, whose strength is not expended even when they reach Ascension and St. Helena. Mrs. Gill's description of life in Ascension, and especially of the life of the "expedition," is given with a good-natured and graphic pencil. At first the observatory was established on an admirable piece of ground at George Town (or "Garrison," as it is called on the island), on the West Coast, where a very nice cottage was allotted to the astronomer and his wife. Her housekeeping difficulties are amusing enough to read of, though at first awkward enough to one unaccustomed to garrison or rather naval life. Ascension is to all intents and purposes one of her Majesty's ships at anchor, and everything is conducted exactly as on shipboard. All food and drink are served out at fixed time as rations, and as supplies are at all times limited, there is ample room for economical management, and little room for luxury and extravagance. The new-comers soon became accustomed to the routine of the land-ship, and after a day or two got comfortably settled in their cottage, and had the heliometer and other instruments most satisfactorily located on their solid asphalte floor. But, unfortunately, this happy state of things was not without a cloud—a real genuine cloud—which threatened to frustrate the great object of the voyage and all the preparations. This